Postural alterations in male Brazilian athletes who have participated in international muscular power competitions

Jayme Neto Júnior[1], Carlos Marcelo Pastre[2] and Henrique Luiz Monteiro[3]

ABSTRACT

High performance sports are characterized by determining specific physical standards that overcome the geopolitical, social and cultural barriers. These peculiarities are also translated in posture alterations that are associated to the efficiency of sport gesture, and at long-term, developing chronic disease. The objective of the present study was to describe the postural profile of athletes who participate in muscular power competitions, and to identify the kinesiological processes responsible for the main body alterations. The group was composed of 15 male athletes, who participated in tests of muscular power. The protocol for data collecting was elaborated based on the proposal of Kendall for the physical observational exam, and Souchard for the postural analysis by muscular chain. All the evaluations were performed during Winnipeg 99' Pan American Games. The results showed that the ankle valgus (67%) was the most common situation; the internal rotation of the hip to the right side (60%), followed by the highest opposite side (47%). This may be related with the run in curve; the hip flexor muscle and knee flexor muscle were observed in the 73% of the cases; this alteration contributes to the low back pain (73%) and, in consequence, it unchains compensatory mechanism of retraction of the posterior muscular chain, causing the thoracic alteration (53%) and the forefront head (73%).

Key words: Injuries. Posture. Sports.

INTRODUCTION

The American Orthopedics Academy considers posture as a balance state of muscles and bones capable of protecting other structures of the human body from injuries in standing, sitting or in lying positions[(1)]. The muscular unbalance, in turn, is defined as a dysfunction of the musculoskeletal system; the body movements result in muscular chains and when postural alterations occur, the organism reorganizes itself in compensation chains, searching for an adaptive response for such disharmony[(2)].

Thus, the repetition of some types of activity with usual positions and movements as well as the overtraining and overuse lead to an organic adaptation process that results in harmful effects for posture with high muscular unbalance potential[(3)]. Additionally, the sports specific gestures and the misconceive of the movements' performance technique may increase the prevalence of lesions[(4)].

In this context, one may affirm that the body is in perfect balance when the vertical line drawn from its center of gravity results exactly in its sustentation basis[(2)]. However, in order for the muscular chains to remain in balance condition, any unbalance should be compensated by an inverse unbalance of same value and level.

Studies report that the body posture alignment is established by musculoskeletal structures that interact for lifetime according to its requirements[(5)]. Thus, high-level sports are characterized by determining body standards specific to the modality practiced that overcome the geopolitical, social and cultural barriers. In other words, it is worthy saying that the exposition to a specific physical exercise and intense routine, typical of each modality, produces an esthetic result that does not regard nationality, ethnic group and life habits that athletes are submitted to. These peculiarities are also characterized by postural alterations associated to the efficiency of the sportive gesture[(6)]; however, these alterations may develop into chronic processes at long-term that limit the individual for the practice of physical activities.

In fact, most postural problems may be attributed to the routine organization of the sportive training, where the overload work trends to occur in the most requested muscular groups (responsible for the athletic gestures), regardless the effect of these gestures on the deep muscles that act on the posture maintenance[(3)]. In this context, as important as the development of specific qualities for the high performance, should be the concern with posture and muscular balance, once these factors influence the yield of the athlete and may minimize the incidence of sportive lesions[(7)].

OBJECTIVE

The objective of the present study was to describe the postural profile of athletes who participate in muscular power competitions and to identify the kinesiological processes responsible for the main body alterations.

SAMPLE AND METHOD

1) Characterization of the subjects studied

The investigation sample was composed of 15 male athletes with age ranging from 19 to 28 years, who have participated in international muscular power competitions. It is worthy mentioning that this group has participated in six World Championships, two Pan American Games, three Olympic Games, one Athletics World Cup, six Iberian-American Championships and five South-American Championships, thus being characterized as the elite of the Brazilian athletics. All participants signed an informed consent form and their privacy were respected.

2) Definition of the investigation protocol

The protocol for data collecting containing information about the postural evaluation such as feet, tibia, pelvis, column and head examinations, was elaborated based on proposal of Kendall *et al.*[(6)] for postural and observational evaluation. In this context, the athlete was positioned in orthostatic position in the simetrograph with heels slightly apart and feet abducted about 15 degrees, searching

1. Master Degree Professor, Physiology Department, Technology and Sciences School, Unesp – Presidente Prudente; Couch of the Brazilian Athletics Team (1992-2003).
2. Professor, Physiology Department, Adamantina Integrated College; Master degree in Health Sciences; Physiotherapist of the Brazilian Athletics Team.
3. PhD Professor, Physical Education Department, Sciences School – Unesp – Bauru.

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Correspondence to: Henrique Luiz Monteiro, Rua Charles Lindenberg, 3-50, Jardim Europa – 17045-620 – Bauru, SP.

for asymmetries at the front, sagittal and transversal levels. To do so, simetrograph, plumb bob, photograph camera Yashica FX-3, Super 2000 and skin markers were used. For the analysis of the posterior static master chain (posture 1), composed of spine, gluteus minimus muscle and sural triceps muscles and the muscles of the anterior static master chain (posture 2) that comprehends the scalene, intercostal, diaphragm, psoas and anterior leg muscles, the protocol based on proposal of Souchard[8].

In posture 1 the athlete was asked to stand on a 30º-inclination slope with knee extension and hip flexion at 60º, in order to avoid any compensation. The posterior chain was considered as retracted in athletes who could not maintain the position requested, presenting the following alterations: spine low-back pain, horizontal pelvis, knees flexors, genuvarum or hollow feet.

In posture 2 the athlete was asked to sit down on a table with lower limbs in extension. The pelvis and lumbar column positioning was observed. The muscular retraction diagnosis was observed when the athlete could not lean against ischium, producing retroversion of the pelvis and consequently inversion of the lumbar curvature.

In the retraction evaluations of the hip flexor and knee extensor muscles, the protocol used was elaborated based on proposals of Kendall *et al.*[6].

For the examination of knee extensors the athlete was positioned over a stretcher in dorsal decumbent position with lower limbs out of it and a flexometer fastened to the medial third of leg to be tested with inferior extremity at zero degree in relation to the tibia longitudinal axis. Following, the hip and knee flexion was requested at 90 degrees in relation to the non-tested limb with the other limb at vertical position, being considered as retraction when the flexometer measure indicated less than 80 degrees.

In order to test the knee flexors, the athlete was positioned over a stretcher in dorsal decumbent position, non-tested limb fixed and stabilized on the stretcher. The tested leg was positioned with hip and knee flexion at 90 degrees, the flexometer fastened to the medial third of leg to be tested with inferior extremity at zero degree in relation to the stretcher. Following, the knee extension was requested up to the maximal amplitude as possible. The retraction was considered when flexometer measure indicated less than 80 degrees.

In the evaluation of the hip flexors, the same position as the knee flexors test was used, however, the retraction was considered when the thigh of the tested leg loses contact with the stretcher.

3) Data collecting and analysis of information

Before data collecting, each participant was informed of the evaluations that they would be submitted to, by signing the Informed Consent Form, which procedure was authorized by the Health Department of the Brazilian Olympic Committee (COB) and Athletics Brazilian Confederation (CBAt).

The evaluations were performed in the competition period, in other words, when the organism already suffered postural alterations as result of the sportive gesture specialization. The athletes wore only bathing suit when the evaluator performed the posture analysis *in vivo* – an assistant concurrently photographed the position corresponding to its interpretation.

According to Tunes and Cote Gil[9], the specific models for the analysis of body segments or pairs of segments trend to provide detailed information. However, only this initiative does not necessarily mean accuracy, once they are also affected by limitations that reach any recording performed by evaluators. In order to minimize possible bias of interpretation from evaluator, the photograph documentation was later used for the confirmation from other expert of the diagnosis issued by the evaluator; in this case, the second evaluator did not consider previously the conclusions issued by the first one. The information about postural alterations disposed in electronic spreadsheet is the result from the agreement of both evaluators. The data were organized as tabular representation with relative and absolute frequencies distribution.

RESULTS

Table 1 presents the frequency distribution of postural alterations observed in 15 elite athletes who participated in international muscle power competitions, according to body segment. The valgus feet position was observed in 67% of cases, while 53% presented hollowed feet. In the pelvis region, the retroversion presented the highest rates (73%), hip elevation to the left side (47%) and pelvis internal rotation in 67% of athletes. With regard to the vertebral column, 73% are carrier of low-back pain and 53% of cervical low-back pain. The head forefront was the postural alteration observed in 73% of cases.

TABLE 1
Frequency distribution of postural alterations observed in elite athletes who participated in international muscular power competitions, according to body segment

Body region	Postural alteration	Frequency	
		Absolute	Relative
Ankle/Foot	Flat	3	20.0
	Hollow	8	53.0
	Valgus	10	67.0
	Varo	2	13.0
Tibia	Internal rotation	7	47.0
	External rotation	1	0.07
Pelvis	Internal rotation	9	60.0
	Highest right	4	27.0
	Highest left	7	47.0
	Anteversion	11	73.0
	Retroversion	2	13.0
Column	Low-back pain	11	73.0
	Lumbar rectification	3	20.0
	Increased thoracic humpback	8	53.0
	Cervical low-back pain	8	53.0
Head	Forefront	11	73.0

Table 2 presents the frequency distribution of muscular retractions observed in athletes who participated in international muscular power competitions according to body segment. At the hip region, it was observed that 67% of the investigated athletes presented retracted flexor muscles. It was also observed that 73% of cases presented knee extensors retraction and 60%, knee flexors retraction. In the analysis of the posterior chain, the retracted posture 1 occurred in 60% of cases and the retracted posture 2 occurred in 80%.

TABLE 2
Frequency distribution of muscular retraction observed in elite athletes who participated in international muscular power competitions, according to body segment

Body region	Retraction alteration	Frequency	
		Absolute	Relative
Hip	Retracted flexor muscles	10	67.0
Knee	Retracted extensor muscles	11	73.0
	Retracted flexor muscles	9	60.0
Posterior chain	Retracted posture	9	60.0
	Retracted posture	12	80.0

DISCUSSION

The valgus position of the ankle was detected in 67% of cases. Similar situation was also observed among athletes who participated in the 46th edition of the Brazil Athletics Meeting that took place in Rio de Janeiro in 1997; in this case, 76.1% of athletes presented the same foot posture alteration[7].

The most reasonable explanatory hypothesis is that this phenomenon is due to the neuromuscular proprioception blockage mechanism of the segment analyzed caused by the excessive and inadequate use of footwear, that reduces the sustentation of the 26 foot bones that, in turn, fall down medially due to the anatomical facility under the action of the body weight, thus inducing postural reactions responsible for the maintenance of the static posture, with the occurrence of the valgue position of the foot. Consequently, studies[2,10] report that the internal rotation of the tibia is presented as a secondary alteration as result of the valgue foot compensation mechanism (47%).

The internal rotation of the pelvis to the right side on the horizontal level (60%) followed by the highest opposite side (47%) may be related to the run in curve in the racetrack, where the hip anatomical structure is strongly requested for the maintenance of the speed with concurrent change of direction in function of the gravitational force. Thus, the pelvis-trochanteric muscles act towards the external rotation[11] asymmetrically in unipodal backing, trending to be shortened due to the strong solicitation.

In the present investigation, the retroversion of the pelvis was observed in 73% of cases. Generally, this problem is a result of the hip flexor and knee extensor muscles retraction, which contribute to the formation of the low-back pain (73%) that, in turn, unchains retraction compensation mechanisms of the posterior chain, causing thoracic humpback (53%) and forefront head (73%). Table 2 confirms these results that are in agreement with the postural chain alterations.

The pelvis waistline is characterized as a complex structure of the human body sustentation for both static and dynamic activities. The pelvis is maintained by strong ligaments of 28 muscles that are originated or inserted in the lumbar-pelvic structure, performing a large variety of forces responsible for the maintenance of the body stability. Generally, the pelvis waistline alterations are never primary and their causes are always associated to compensation mechanisms in the lumbar column stabilization processes[12].

With regard to the exposition that unchains the change processes in the muscular chains, some authors believe that these alterations are strongly related to the biomechanics of the modality involved, to the tonus variation and muscular tropism, and to the lateral dominancy among others that may cause severe or chronic lesions at long-term, diminishing significantly the athletes' yielding[7,12].

Studies reveal that runners who present chronic and severe episodes as result of the posterior chain muscular retraction find explanations from experts that attribute the problem to the type of surface and footwear, disregarding factors related to posture and type of training. Generally, when recurrences are frequent, they commonly recommend the athlete to quit physical activities[13,14]. They even mention that low-back pain may result in severe macrolesions, repetitive micro-lesions (stress) or the combination of both mechanisms. In this context, in a study on sportive lesions in football players related to posture deficiency, it was observed that 51.9% of individuals presented excessive and moderate increase of low-back pain and that, in these alterations, a high incidence of knee injuries and muscular lesions[15]. These studies also emphasize that there is a relation between bad posture and incidence of sportive lesion. With regard to high performance athletes, these studies report that the thoracolumbar vertebra anatomical abnormalities are frequently diagnosed through magnetic resonance and the alterations seem to be associated to the symptoms.

In this context, the precocious diagnosis of postural alterations and the adoption of effective prophylactic measures may prevent the occurrence of sportive lesions, as well as to contribute for the increase on the athletes' performance. As time passes, the impact of adequate intervention procedures at different periods of the athlete's training contributes for his quality of life, also minimizing the effect of chronic processes acquired with high-intensity bodywork. These data indicate that the prophylactic measures during pauses between training session trend to become as important as the own effort performed in each exercise session. Thus, the relevance of the participation of physiotherapy professionals as a sportive training multi-professional staff is emphasized.

CONCLUSIONS

From the results found in this study one may conclude that the group studied presented specific postural characteristics such as low-back pain, retroversion of the pelvis and head forefront as result of hip flexor and knee extensor muscle retraction unbalances. Studies involving physiotherapy interventions will evaluate if there is a reduction on the chronic effects that postural alterations resulting from training cause to high-performance athletes.

All the authors declared there is not any potential conflict of interests regarding this article.

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